Shelford (W.) and A. H. Shield. On some points for the consideration of English Engineers with reference to the Design of Girder Bridges. 8vo. *London* 1886. The Authors.

Trois (Enrico F.) Annotazione sopra un esemplare di Trygon Violacea. 8vo. *Venezia* [1886]; Considerazioni sul Dentex Gibbosus. 8vo. *Venezia* 1886. Prof. T. R. Jones, F.R.S.

January 27, 1887.

Professor G. G. STOKES, D.C.L., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "On a Perspective Microscope." By GEORGE J. BURCH. Communicated by J. RUSSELL REYNOLDS, M.D., F.R.S. Received January 7, 1887.

(Abstract.)

In 1874 the author discovered a form of microscope giving constant magnification along the optic axis, so that objects were shown by it in microscopic perspective.

By writing $(f_1+f_2+\mathrm{H})$ for the distance between two thin lenses, he obtained for the formula of the system

$$\frac{f_2(f_2+\mathrm{H})u-f_1f_2(f_1+f_2+\mathrm{H})}{\mathrm{H}u-f_1(f_1+\mathrm{H})}=v;$$

u being the distance from the object to the first lens, and v that from the second lens to the image.

Putting $\mathrm{H}=0$ in this equation, three things result.

1. dv/du, which represents the longitudinal magnification, becomes constant, namely $-(f_2/f_1)^2$;

2. The lateral or angular magnification, f_2/f_1, is also constant;

3. A picture of an object so magnified, drawn with the camera lucida, when viewed from a distance f_2/f_1 times less than that at which it was drawn has the perspective belonging to an object magnified $(f_2/f_1)^2$ times.

The distance at which the eye must be placed is great, but may be reduced by employing three lenses, the distance between the first and

second being $(f_1+f_2+f_2/m)$, and that between the second and third $(f_2+f_3+mf_2)$.

If the lenses are nearly but not quite in the afocal position, greater power and a wider field may be obtained, but it is at the expense of the penetration, which may, however, with advantage be limited to the thickness of the object. The instrument offers great advantages for artistic purposes, but lenses or mirrors of specially wide angle are needed for the farther development of the invention.

The optical conditions of a system of two thin lenses at varying distance apart are shown by diagrams.

In Diagram I the u and v of the formula employed are set off as abscissæ and ordinates, and the curves (which are rectangular hyperbolas) drawn for several values of H. In the afocal position of the lenses the curve degrades into a line which is a tangent to all the hyperbolas at the point (f_1, f_2). The locus of vertices and locus of centres of these curves being straight lines, and the hyperbolas all touching the point (f_1, f_2), it is shown that the principal foci, principal points, and equivalent focal length for any given position of the lenses can be found by rule and compasses, without drawing the curve.

In Diagram II the actual position of the lenses, their principal foci, separate and combined, and the principal points, positive and negative (answering to the vertices of the curves in Diagram I), are plotted down as abscissæ, the values of H on an enlarged scale being taken as ordinates.

Diagram III shows the same for two lenses of equal focal length.

Comparison of these two diagrams suggests the employment of the term "Pseudo-Principal Points" for those positions at which the magnitude of the image is in the constant ratio f_2/f_1 to that of the object for every value of H, inasmuch as the distance from these to the principal points gives the measure of the "penetration" of the system.

II. "On the Thermodynamic Properties of Substances whose Intrinsic Equation is a Linear Function of the Pressure and Temperature." By Professor GEORGE F. FITZGERALD, M.A., F.R.S. Received January 11, 1887.

Professor Ramsay has communicated to me that he and Mr. Young have found that within wide limits several substances in the liquid and gaseous states have the following relation connecting their pressure (p), temperature (T), and specific volume (v),

$$p = a\mathrm{T} + b,$$

where a and b are functions of v only.